

FOREWORD

HAZ-ED **Classroom Activities for Understanding** **Hazardous Waste**

One out of four Americans lives within four miles of a Superfund hazardous waste site. There are Superfund sites and many other hazardous waste sites in every state. Every community generates hazardous waste.

The Federal Superfund Program, administered by the U.S. Environmental Protection Agency (EPA), investigates and cleans up hazardous waste sites throughout the United States. Part of this program is devoted to informing the public and involving them in the process of cleaning up hazardous waste sites from beginning to end. Haz-Ed was developed to assist EPA's efforts. Haz-Ed assists educators in teaching 7th through 12th grade students about hazardous waste, environmental issues surrounding site cleanup, and the Federal government's Superfund Program.

Haz-Ed can be used as part of a larger curriculum, as special stand-alone activities, or on an occasional basis to teach students about hazardous waste issues. Haz-Ed is a compilation of interdisciplinary activities that focus on the often complicated and sometimes controversial scientific, technical, and policy issues related to hazardous waste sites and Superfund. It is designed to help students develop skills in critical thinking, problem solving, and decision making. It also increases environmental awareness and encourages an environmental ethic in students.

EPA hopes Haz-Ed will be beneficial to you in your efforts to educate your students about the environment and the environmental concerns we all share. If you have any questions concerning Haz-Ed or the Superfund Program, please contact Jean Farrell of Superfund's Community Involvement and Outreach Center, at 703-603-9055.

Acknowledgements

The U.S. Environmental Protection Agency sincerely appreciates the valuable contributions of the following education and environmental professionals to Haz-Ed: Classroom Activities for Understanding Hazardous Waste.

Carol Adkins
Linda Andrews
Cindy Byers
Steven Coon
Nancy L. Cronin
Katie Daly
Rodney J. Dymesich
Mark Elworthy
CeCe Forget
Scott Fredericks
Gayle Fritsch
Joanna Gibson
Robert Hubert
Alice Jasmer
Kathleen Kaye

Larry Manc
Judith Mealing
David Miller
Douglas Reindl
Laurie Low Reser
Paul Rowland
Gretchen Schmidt
Ron Slotkin
Joseph Smogor
Valerie Stone
Helen Lynn Vella
Helen Waldorf
Debra Weitzel
Midge Yergen

CONTENTS

Introduction

Instructional Goals

What This Package Contains

How To Use This Package

Warm-Up Exercises

- | | | |
|----------|--|-----------|
| 1 | Defining Hazardous Waste | 3 |
| | Students define and explore the relationship between hazardous substances and hazardous waste. | |
| 2 | EPA's Superfund Program—Overview | 7 |
| | Students learn about the goals of the Federal Superfund Program and how these goals are achieved. | |
| 3 | The Numbers Game | 17 |
| | Students gain an appreciation for the part-per-million and part-per-billion units used to measure contaminant concentrations in the environment. | |
| 4 | Risk Concepts | 27 |
| | Students explore the meaning of risk through a simple exercise in probability. | |
| 5 | Hazardous Waste Issues in the News | 33 |
| | Students conduct research to collect news media reports on' local and national hazardous waste issues. | |
| 6 | What Is an Aquifer? | 43 |
| | Students build a simple model of an aquifer to study the relationship of groundwater and surface water and explore the ways contaminants are spread through water. | |

Activities

- | | | |
|----------|--|-----------|
| 1 | Waste: Where Does It Come From? Where Does It Go? | 49 |
| | Students identify and locate on a map the potential sources of hazardous waste in their neighborhood or community. | |

2	Examining a Hazardous Waste Site	53
	Students begin to understand how Superfund sites are created.	
3	Companion to Superfund — the Resource Conservation and Recovery Act (RCRA) Program	61
	Students explore the nation's program for properly managing and disposing of hazardous and nonhazardous waste in the United States.	
4	Dealing with Chemical Emergencies	67
	Students discover how Federal, state, and local authorities respond to chemical emergencies under Superfund and other laws.	
5	How Hazardous Substances Affect People	73
	Students gain an appreciation for how scientists determine the human health effects of hazardous substances.	
6	Examining The Effects of Pollution on Ecosystems	81
	Students learn that hazardous waste may have far-reaching impacts on ecosystems that are not-always easy to identify.	
7	Identifying Risks at a Superfund Site	91
	Students begin to understand the types of risks found at Superfund sites and how these risks are identified and assessed.	
8	Hazardous Waste Cleanup Methods	105
	Students explore some of the reasoning involved in choosing technologies for cleaning up hazardous waste sites.	
9	Making Decisions About Hazardous Waste Cleanup	109
	Students assume roles and act out a situation that illustrates the process of decision making during cleanup of a Superfund site.	
10	Pollution Prevention	127
	Students discover what can be done to reduce the amount of solid and hazardous wastes that must be disposed of and managed safely.	
11	What the Community Can Do	135
	Students learn how the U.S. Environmental Protection Agency involves communities near Superfund sites in the cleanup process, and the types of activities communities can use to influence how hazardous waste sites are	
12	Federal and State Laws on Hazardous Waste	141
	Students will become familiar with how laws affecting hazardous waste are developed, enacted, implemented, and enforced.	
13	Creating the Future	149
	Students create and write scenarios for the future related to hazardous waste pollution.	

Fact Flashes

- 1 Hazardous Substances and Hazardous Waste**
- 2 The Superfund Cleanup Program**
- 3 Flowing Railroad Hazardous Waste Site**
- 4 Flowing Railroad Site Investigation Results**
- 5 Groundwater**
- 6 Resource Conservation and Recovery Act (RCRA)**
- 7 Pollution Prevention**
- 8 Common Cleanup Methods**
- 9 Common Contaminants**
- 10 Superfund Community Involvement Program**
- 11 Other Major Environmental Laws**

Glossary

Suggested Reading

Contacts and Resources

***This is Superfund* Brochure**

Bibliography

Evaluation Form

INTRODUCTION

Ten million children under the age of 12 live within 4 miles of a Superfund site. The following education materials were developed to focus the attention of 7th through 12th grade students on hazardous waste, environmental issues surrounding hazardous waste sites, and the Federal government's Superfund Program. The units in this package are designed to help students think critically and creatively about hazardous waste pollution problems and some, alternatives for resolving them. The units are interdisciplinary, with a particular focus on classroom interaction and real-world applicability. They are readily usable in schools with a team-teaching or theme approach. The materials are designed for use in a range of subject areas. A table showing the related subject areas for all units is provided at the end of this Introduction for quick reference.

The Haz-Ed materials focus on laws passed by the United States Congress and implemented through regulatory programs directed by Federal agencies, primarily the U.S. Environmental Protection Agency. These are Federal laws and programs that apply to the entire nation. Each state also has a system of environmental laws and state agencies to implement them. Even some local governments have acted to deal with environmental issues through legislation. Although beyond the scope of this document, information about state and local activities can be very useful to you.

Instructional Goals

The units are designed to fulfill four primary instructional goals. Each unit is hands-on and interactive, giving students practice in:

- Collecting, analyzing, and interpreting data in experiments that illustrate the impact of hazardous waste pollution
- Clarifying value systems—their own and those of others—that impact how we perceive and treat the environment
- Analyzing how economics, laws, politics, technology, and other factors contribute to hazardous waste pollution and the process of dealing with it
- Assessing alternatives for resolving hazardous waste pollution problems.

Students must gain an understanding of the scientific and technical concepts related to the environment, and see that these concepts are useful and applicable in the world. To show the relevance and utility of the concepts and skills underlying these activities beyond the classroom, many of the units challenge students to extrapolate real world applications from the information presented.

What This Package Contains

The package includes 6 **Warm-up Exercises**, 13 **Activities**, and 11 **Fact Flashes**.

These units focus on the most important hazardous waste and site cleanup issues in a simple, straightforward style. Many of them can be completed in one class period, but some require two class periods or portions of several classes over a specified period of time. The number of class periods required for each lesson was determined based on an average class period of 45 minutes. These are estimates and are provided only as a guide. The actual time required will depend on the grade level and the skill level of the students in the class.

Pieces can be used alone or in various combinations to accommodate the needs of individual classes and grade levels. Some educators, for example, may choose to conduct several Warm-ups and Activities in sequence over an entire semester. Complementary units are referenced in each Warm-Up and Activity.

Several lessons begin with homework assignments to prepare students for the exercise. Most units call for explanations or presentations by teachers, but several also involve presentations from students and facilitated discussions led by teachers.

Fact Flashes

The Fact Flashes are a set of fact sheets that provide the foundation of information on which the Warm-Ups and Activities are built. The Fact Flashes stand alone and can be used to supplement your lessons in a number of ways.

Warm-Up Exercises

The **Warm-Ups** focus on developing and understanding some basic concepts related to hazardous waste. These exercises are designed to be presented by classroom educators in series or as preparation for related Activities.

Activities

The **Activities** build on the Warm-ups, although they can stand alone. Students examine issues related to hazardous waste and site cleanup. The Activities are designed for presentation by classroom educators. Since some of the Activities take more than one class period, however, educators may wish to consider sharing the delivery with an invited guest, such as an EPA Superfund staff member or an employee of the state government's hazardous waste cleanup program.

Duration estimates the time needed for the lesson. The actual time required will depend on the grade level and the skill level of the students in the class.

Purpose explains what the student will know or be able to do following this activity.

Grade Level indicates the target grade levels for this unit.

Key Terms/Concepts shows terms students will encounter in the unit (defined in the Glossary section of the package).

Suggested Subjects are the scholastic subject areas to which the lesson is related.


Background contains basic facts and context information for the educator's use.

Preparation provides a list of materials and steps the educator should complete prior to class.

Procedure sets out step-by-step instructions for executing the lesson. Wherever appropriate, this section includes questions the educator should ask or anticipate from the students, student worksheets, and answer keys.

Activity 1

Waste: Where Does It Come From? Where Does It Go?



Duration: 2 class periods

Grade Level: 9-12

Key Terms/Concepts: Hazardous waste

Suggested Subjects: Biology, Chemistry

Purpose

In this lesson, students use a map to identify and locate potential sources of hazardous waste in their neighborhood or community. In the process, students learn what hazardous waste is and identify the potential threats it poses.

Background

Our lifestyles are supported by complex industrial activities that produce vast quantities of waste. Industries that produce our clothing, cars, paper, medicines, plastics, electronic components, fertilizers, pesticides, and cosmetics—to name only a few—use and discard thousands of hazardous chemicals and other substances every year.

Preparation

1. Place the map on a easel or hang it on a wall where students can see it.

Procedure

1. Summarize information found in Fact Flash 1 and your research in preparing the class, including how hazardous waste sites are created from a variety of sources.

Extension (Optional)

- Allow the class to choose specific ideas they want to pursue and design a plan of action. Monitor and facilitate their progress until completion.

49

Extension (Optional) offers ideas for carrying the lesson further by suggesting follow-up, extra-credit activities, or ways to expand participation beyond the classroom.

Appended Materials

At the end of this document you will find several resources and supplements that can assist you in making the most of Haz-Ed or support your independent activities. The **Glossary** defines many of the terms and concepts students will encounter in the exercises and activities. You may consider providing your students with a copy for their general reference.

A list of abstracted **Suggested Readings** provides both educators and students with additional information. The list is keyed for grade level and provides references to the most relevant exercises and activities.

A list of **Contacts and Resources** provides a variety of information, including key phone numbers and Internet addresses.

A brochure, ***This Is Superfund***, is a stand-alone document that describes the Superfund Program. It can be used in the classroom and the community.

Finally, the **Bibliography** lists resources used in preparing the Haz-Ed materials.

How To Use This Package

These materials are intended as resources. Educators should feel free to make adjustments in the material to fit in with topics and concepts the class may already be studying or to address topics of particular importance to students in a given geographic area. Also, we encourage educators to use their knowledge of the make-up of the community to add texture to the lessons and reinforce students' in-classroom work. Educators are reminded to consider economic and cultural sensitivities in using the materials that involve living creatures or procuring materials.

How educators and guest presenters deliver these lessons is all-important. Helping students think critically about the world around them and their role in preserving the environment underlies all the materials. Many of the activities involve technical vocabulary and concepts, and instructors may need to spend extra time defining terms and providing background. Accelerated students may not have a problem, but others may. Grade levels listed in the materials are only suggestions; select and adapt these materials to your students' abilities and needs. Feel free to copy these materials and share them with other educators.

Most units provide questions to stimulate student discussion, but few have a single, “right” answer. These questions are intended to draw on the students’ abilities to identify various options, Strategies, and reasons in arriving at their answers. Educators can ask students to describe how they arrived at a particular answer and encourage them to compare their answers and approaches with those used by other students to answer the same question. Where there may be several answers to the same question, challenge students to explore why answers are different and how to determine which, if any, are correct. This approach helps students develop critical thinking skills in a stimulating, noncompetitive environment.

Subject Areas for *Haz-Ed* Lessons

	Biology	Chemistry	Civics/Government	Creative Writing	Drama	Earth Science	English	Geography	Geology	Health	History	Journalism	Life Science	Mathematics	Physical Science	Physics	Social Studies
Warm-up 1									✓			✓		✓		✓	
Warm-up 2			✓									✓		✓		✓	
Warm-up 3													✓				
Warm-up 4	✓	✓		✓		✓						✓	✓	✓			
Warm-up 5		✓		✓			✓			✓	✓	✓		✓		✓	
Warm-up 6						✓								✓			
Activity 1	✓	✓							✓			✓		✓		✓	
Activity 2		✓				✓		✓						✓			
Activity 3			✓											✓		✓	
Activity 4		✓												✓			
Activity 5	✓	✓										✓					
Activity 6	✓	✓										✓		✓			
Activity 7		✓				✓		✓						✓			
Activity 8	✓	✓	✓									✓		✓	✓		
Activity 9			✓		✓				✓			✓		✓		✓	
Activity 10		✓	✓										✓	✓		✓	
Activity 11			✓		✓											✓	
Activity 12			✓													✓	
Activity 13				✓	✓		✓				✓	✓				✓	